האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

# *The Hebrew University of Jerusalem*

## *Syllabus*

# *THEORETICAL AND COMPUTATIONAL NEUROSCIENCE B - 76909*

*Last update 19-02-2014*

*HU Credits:* *4*

*Degree/Cycle:* *2nd degree (Master)*

*Responsible Department:* *Brain Science: Computation & Information Proc.*

*Academic year:* *0*

*Semester:* *1st Semester*

*Teaching Languages:* *English*

*Campus:* *E. Safra*

*Course/Module Coordinator:* *Haim Sompolinsky*

*Coordinator Email:* *haim@fiz.huji.ac.il*

*Coordinator Office Hours:* *By appointment*

*Teaching Staff:*
*Prof Yoram Burak*
*Mr. Haggai Agmon*
*Ms. Gal Vishne*

*Course/Module description:*

*Course/Module aims:*

*Learning outcomes - On successful completion of this module, students should be able to:*

*Attendance requirements(%):*
*0*

*Teaching arrangement and method of instruction: Lecture and Recitation sessions*

*Course/Module Content:*
*I. Introduction to Computational Neuroscience*

*II. Principles of sensory processing:*
* *Receptive fields and Efficient Coding*
* *Information, Mutual Information, Entropy, and MaxEntropy*
* *The Gaussian Ensemble*
* *Infomax*
* *Vision: Natural image statistics and Infomax predictions*
* *Beyond Gaussianity*
* *ICA*
* *Compressed sensing and sparse coding*

*III. Neural Population Codes*
* *Statistical characterization of neuronal population codes.*
* *Fisher information theory and ML estimation/decision*
* *Correlated population coding*
* *Biological readouts*
* *Spike based neural code*

** Bayesian computation in neural systems*

*IV: Network dynamics and computation*
** Rate based Models, Linear networks: Fixed Points and Stability, Symmetric networks, energy functions*
** Non-linear networks: Attractors, Lyapunov functions, symmetric networks*
** Spatial computation: spatial working memory, head direction, place cells and grid cells*
** Spatial computation: models*
** Asymmetric networks: linear networks and temporal working memory.*
** Dynamics and computation in chaotic neuronal networks*
** Balanced networks*

*Required Reading:*
*none*

*Additional Reading Material:*

*Course/Module evaluation:*
*End of year written/oral examination 70 %*
*Presentation 0 %*
*Participation in Tutorials 0 %*
*Project work 0 %*
*Assignments 30 %*
*Reports 0 %*
*Research project 0 %*
*Quizzes 0 %*
*Other 0 %*

*Additional information:*
*Home assignment grades will constitute at least 30% of the final course grade.*